

CHAPTER 5

AMMUNITION SAFETY, HANDLING, SHIPPING, AND STOWING

LEARNING OBJECTIVES

Upon completing this chapter, you should be able to do the following:

1. Describe the basic safety principles associated with ammunition handling, shipping and stowage.
2. Describe the explosive handling personnel qualification and certification program.
3. Describe the different types of ammunition stowage and their associated safety devices.

INTRODUCTION

The application of basic safety principles to life's activities is an old precept, practiced from the dawn of time. It was an intuitive, basic survival instinct. However, as society evolved, it became evident that instinct alone wasn't sufficient. The movement toward a technical world required that cohesive thought be applied to matters of safety where dangerous and involved activities were concerned. One such activity is the procuring, stowing, and use of ammunition by the military.

The U.S. Navy has many types of ammunition that must be maintained in a state of readiness at all times. Your life, the lives of your shipmates, and the accomplishment of your mission depend on the quality and condition of this ammunition. To ensure that ammunition will perform as expected, it is prepared, overhauled, and assembled according to exacting specifications. It must also be handled, shipped, and stowed carefully, to prevent mishaps that may result in loss of life and material.

Since you will be near some type of ammunition on almost a daily basis, you will share the responsibility for ensuring that mishaps don't occur. This chapter contains information that will help you understand how to handle, ship, and stow ammunition safely. But before we discuss handling, we must reinforce your awareness of safety.

SAFETY

Your major concern during weapons handling and stowage evolutions must be safety. Safe handling and stowage operations are a team effort. All personnel involved in handling weapons must be trained and qualified to perform their job expeditiously and safely, as prescribed by *Ammunition and Explosives Ashore, Volume 1*, NAVSEA OP 5, *Ammunition Afloat*, NAVSEA OP 4, and NAVSEA OP 3347, *Ordnance Safety Precautions*.

SAFETY PHILOSOPHY

Safety is a state of mind, engendered from the top echelons of command down to the lowest working level through positive action and good leadership. Most accidents result from not applying proper safety principles. These accidents can be prevented, but only with the full cooperation of every person concerned. This means that **safety is a function of all hands**, not just the safety observers. Where explosive munitions are concerned, safety is a way of life and the means of survival for everyone in the general area. To help emphasize the critical nature of safety, we will expand the basic elements of safety in the following paragraphs.

Only by the continuous and vigorous application of these basic elements of safety can the level of ordnance accidents/incidents be reduced and, hopefully, eliminated.

Throughout the remainder of this chapter, keep the following factors in mind:

- Your knowledge of safety principles should be sound and based on thorough training.
- Your application of safety principles should be under close and constant, qualified supervision.

SUPERVISORY DUTIES

Anyone who supervises the inspection, care, preparation, handling, use, or routine disposal (excluding EOD operations) of ammunition or explosives must satisfy the following requirements:

1. Be qualified and certified as required by OPNAVINST 8023.2, *U.S. Navy Explosives Safety Policies, Requirements, and Procedures (Department of the Navy Explosives Safety Policy Manual)* and supplemental regulations.
2. Remain vigilant throughout the operation, and ensure that all regulations and instructions are observed.
3. Carefully instruct and frequently warn those under them of the need for care and constant vigilance.
4. Before beginning an operation, ensure that all subordinates are familiar with:
 - a. the characteristics of the explosive materials involved,
 - b. the equipment used, safety regulations to be observed, and
 - c. the hazards of fire, explosion, and other catastrophes that the safety regulations are intended to prevent.
5. Be alert to detect any hazardous procedures or practices, or symptoms of a deteriorating mental attitude of certified personnel, and take immediate corrective action when necessary.
6. Limit the number of personnel working with explosives or ammunition to the minimum required to perform the operation properly. Unauthorized personnel must not be permitted in magazines or in the immediate vicinity of handling or loading operations involving explosives or ammunition. Authorized visitors must be properly escorted.
7. Be alert for any hazardous procedures or practices arising from carelessness or attempts

to expedite ammunition or explosives handling operations.

8. Consult pertinent ordnance publications (OPs) to ensure that all personnel comply with specific safety precautions concerning the handling, stowage, and transportation of the ammunition involved.
9. Report accidents. When a supervisor is aware of an accident in his or her area of responsibility, he or she must immediately stop the ammunition operations. In addition to performing required on-scene duties, the supervisor must determine the circumstances and personnel involved in the accident in order to prepare an accident report.

SAFETY PRECAUTIONS

Safety precautions state clearly, concisely, and in the simplest language what may or may not be done. They should be easy to understand and not subject to misinterpretation. They should be explicit and allow no recourse, but should be general enough that they can be applied to similar situations that may arise in the future.

Safety precautions are a serious matter. They are designed to protect the well being of everyone on board and, in some cases, the ship itself. Safety precautions that use terms such as “shall,” “will,” and “must,” have the force of an order and must be obeyed. Safety precautions using the terms “should” or “may” are to be followed as a matter of policy. Deviation from safety precautions is permitted only where it is fully justified by the urgency of the situation.

Certain safety precautions are presented as visual signs or written captions embedded in the text of technical manuals to notify you of a possible danger to personnel or damage to equipment. In such cases, each precaution is mentioned as a WARNING or CAUTION immediately before the procedural directions to which it pertains.

WARNINGS. Hazards that can cause personnel injury are indicated in notes headed by the word “WARNING.” These warnings generally fall into three categories.

- Warning against poisonous fumes or harmful fluids.
- Warning against explosive or flammable components.

- Warning against mechanical hazards. These warnings are normally brief, such as calling attention to the danger involved in standing under a suspended weapon. Operating personnel reading such warnings are expected to use common sense in avoiding the hazard.

CAUTIONS. These are captions that draw attention to situations that may be potentially damaging to equipment. They are mentioned in notes headed by the word “CAUTION.” A typical caution might be written for improper lifting, pushing, or pulling on control surfaces during the handling of projectiles.

A related type of caption, **NOTE**, follows applicable steps that direct action and amplify the action to be performed. Notes that precede a procedural guide (PG), operation procedure (OP), or check list (CL) amplify the entire procedure.

In summary:

WARNING—Warns of danger to personnel.

CAUTION—Warns of danger to equipment.

NOTE—Amplifies information or instruction.

Since we will discuss various handling methods in this chapter, we will first list several of the **GENERAL** safety and maintenance rules that apply to all handling evolutions:

1. Verify that the surrounding area is clear of personnel and obstructions before you operate equipment.
2. Restrict noise and conversation to the minimum required to perform the evolution.
3. Do not stand or walk under suspended loads or weapons.
4. Do not load handling equipment above its maximum rated capacity (safe working load). Before you use handling equipment, inspect it according to the applicable Maintenance Requirement Card (MRC) and type commander's directives.
5. Do not raise weapons higher or suspend them longer than necessary.
6. Keep weapons as level as possible when you lift them.
7. Do not allow weapons to contact any deck or equipment during lifting.
8. Verify that hooks used to handle weapons have operable safety latches or are moused.
9. Ensure that guide studs on weapons are aligned with the guide slot during loading and unloading.
10. Do not allow weapons to be unrestrained, in any direction, unless you are directed to do so in the procedure.
11. Use toxic cleaning agents sparingly and in well-ventilated areas. Vapors of most cleaning agents are toxic if inhaled in large quantities for extended periods. Be sure that cleaning agent containers are kept closed except when in use. Wash your hands thoroughly with soap and warm water after using these agents.
12. Use flammable cleaning agents and paints sparingly and only in well-ventilated areas. Be sure that no sparks, open flames, or other sources of ignition are present when you use these materials.
13. Do not strike or drop high-explosive components. Be sure that no sparks, open flames, or other sources of ignition are to be present when you work with explosives.
14. Observe all precautions for handling explosives. Do not remove an armed exploder from any weapon. Only EOD personnel may remove an armed exploder.
15. Ground yourself immediately before you touch an electrical connector or wire connected to a weapon by making bare skin-to-metal contact with the weapon.
16. Inspect all electrical connectors for bent pins and other physical damage. Always engage and disengage electrical connectors by holding the connector, never the wire.
17. Do not connect or disconnect energized electrical connectors unless you are directed to do so by authorized procedural documentation.
18. Keep the compression system free of foreign material to prevent the spontaneous combustion of oil or other carbonaceous material with hot, highly compressed air.
19. Using extreme care, shut the appropriate valves and bleed all air from lines and bodies before you disconnect fittings.

20. Exercise extreme care to prevent sharp bends or twists in air charging lines.
21. Do not tighten pipe connections or other parts while they are charged with high-pressure air.
22. Do not remove safety straps or chains from charging lines until the charging valve has been shut and the bleeder valve has been opened.

SAFETY SUMMARY

Most procedural guides (PGs), operation procedures (OPs), and checklists (CLs) have a SAFETY SUMMARY located in their front pages. The safety summary lists (one time each) all WARNINGS, CAUTIONS, and NOTES associated with the operation (weapons handling, loading, shipping, employment, emergencies, etc.) and the procedures by which the associated hazards may be reduced or eliminated.

The safety summary is divided into several parts, each consisting of the safety precautions that pertain to the various evolutions for the given weapon. All personnel must be familiar with and adhere to the applicable safety standards. Specific safety precautions are contained in the PG, OP, and CL as appropriate.

The following safety standards apply to all phases of an operation involving weapons systems:

1. Ensure that a launched weapon, either warshot or exercise, is precluded from striking the firing ship.
2. Prevent an inadvertent launching, arming, or motor start.
3. Ensure that the stowage, handling, maintenance, and testing operations of the weapon and weapon system minimize the risk of injury to personnel.
4. Strive to minimize the probability that a weapon involved in an accident or incident, or being jettisoned will explode.

Now let's begin, by discussing why you should be qualified and certified to handle conventional explosive devices.

- Q1. *What is the purpose of a "WARNING"?*
- Q2. *What is the purpose of a "CAUTION"?*

EXPLOSIVES HANDLING PERSONNEL QUALIFICATION AND CERTIFICATION PROGRAM

The purpose of the Explosives Handling Personnel Qualification and Certification Program is to ensure that each person is qualified and certified before performing any task involving explosives. An explosives handler must be certified by the command or organizational unit to which he or she is assigned. To be certified, the handler must demonstrate the ability to perform safely all required functions, tasks, or evolutions associated with specified explosives.

Security and aircrew personnel, ammunition working parties, and personnel on watch (who may not handle the explosives directly) may be exempt from personal or team qualification. However, each person must be carefully instructed in the safety precautions and regulations governing the function, task, or evolution to be performed.

CERTIFICATION BOARDS

The commanding officer or officer in charge of each unit or naval activity involved with handling, shipping, and stowing explosives or explosive devices must appoint a certification board for his or her organization. The board must include, as a minimum:

- The cognizant department head (or comparable supervisory representative if the organization does not have defined departments), and
- Not less than one PO1 or senior (or equivalent civilian supervisor) who is certified to perform the specified function, task, or evolution.

In large units or activities, such as aircraft carriers or weapons stations or ammunition depots, the cognizant department head may delegate the responsibility for certification to an appropriate officer or supervisor, with the concurrence of the commanding officer. A commanding officer or officer in charge may augment the certification board with additional personnel from within or outside the command. In small units or activities where a certified PO1 (or senior) is not assigned to the command, and where board augmentation from outside the command is not feasible, the type commander may authorize a waiver of the PO1 requirement.

Initial certification of personnel to perform particular explosive-related jobs may be necessary in instances where no certification board is currently

established (e.g., a newly installed weapons system, the addition of a handling and/or storage capability, or a newly commissioned ship). In most cases, experienced supervisory-level personnel will be qualified for certification. After careful review by the department head (or equivalent supervisor) of all available information relating to the individual's qualifications for the job to be performed, and a personal interview, a recommendation for certification will be made to the commanding officer or officer in charge. Final certification will then be at the discretion of the commanding officer or officer in charge. When a full qualification and certification board is formed later, certification procedures will be conducted for the remaining junior personnel.

PERSONNEL QUALIFICATION

Personnel working with explosives must be qualified as team members, as individual or team leaders, as instructors, as safety observers, or as a quality assurance inspector. Because of numerous weapons, launching devices, and weapon fuzing and loading configurations, explosive devices are segregated into representative family types. You must qualify and be certified only for applicable family types and operational situations. Table 5-1 shows the qualification levels and standards for certification.

Generally, only inert ordnance is used for drill or training purposes. If a training device is not available or if an explosive device for which training is required has no inert model, a closely related family-type inert device must be used for training. Training aids such as mockups, pictures, manuals, exploded views, and films may also be used effectively. When the use of either a family-type device or training aids is not considered to be an effective alternative for hands-on training with a non-inert device, and all safety factors have been carefully weighed, the type commander may authorize hands-on training with explosive devices, but only under qualified supervision.

To become qualified, you must demonstrate proficiency before a certified member of the certification board for each evolution you will perform. You will be required to demonstrate a competent use of applicable documentation and a knowledge of ordnance safety precautions and procedures to the extent required for ensuring that you will comply with sound handling practices and safety instructions.

You must have a working knowledge of all the types of explosive devices with which you may be required to work. Accordingly, you must become qualified and certified for each separate operation and each explosive device not in the same family type.

Another important requirement you must meet before becoming certified is to complete any appropriate Personnel Qualification Standards (PQS). For example, before you are allowed to handle projectiles aboard a frigate, you must complete the PQS for Non-Nuclear Explosive Handling. In addition to these, your command may have locally prepared qualification sheets that you must complete.

CERTIFICATION

When you are qualified and recommended for certification, you will be issued final certification by the commanding officer, the officer in charge, or the designated head of the certification board. An appropriate entry will be made in your training record and service record. Next, let's find out who must qualify and certify for what positions of responsibility.

The following personnel require individual qualification and certification:

1. Personnel whose duties require that they individually handle, inspect, package, unpack, assemble, disassemble, test, fuze, load or download, stow, arm or de-arm explosives or explosive devices must be qualified and certified for such tasks. Personnel assigned as safety observers for explosive operations, and those who inspect explosive operations for quality assurance purposes must also be qualified and certified. Supervisors of explosive operations and members of the command-appointed certification boards must also be individually certified for the evolutions that they may supervise or observe for qualification purposes. The only exception to this provision is that supervisors of explosives handling teams involved in handling explosives/hazardous materials with power-operated handling equipment need not themselves be qualified as operators. They must, however, be certified as team leaders for the explosive operations being conducted.

2. All operators of power-operated handling equipment (hoists, winches, cranes, forklifts, and so forth) used in transporting, loading, or handling ammunition, explosives, and other hazardous materials must be both certified and licensed as ground support equipment and/or materials handling equipment operators. Civilian personnel who operate these types of

Table 5-1.—Qualification Levels and Minimum Standards for Certification

CERTIFICATION LEVEL	QUALIFICATION STANDARD
IN TRAINING (IT)	<ol style="list-style-type: none"> 1. Incumbent is required, by nature of duty, to perform work tasks with explosive devices while under direct supervision of a certified team leader (TL) or individual (I). 2. Incumbent is receiving training on newly introduced explosive devices for which inert training devices are not available. 3. Incumbent shall not work with explosives unless supervised by TL or I. 4. This level of certification is temporary until such time full qualification justifies certification at a higher level, for example, TM, or I.
TEAM MEMBER (TM)	<p>BASIC QUALIFICATION. Personnel are aware of basic safety precautions relative to the work task and explosive devices concerned, have received formal and/or on-the-job training, and have been recommended by their immediate supervisor. May not work with ordnance unless supervised by TL or I.</p> <p>NOTE: TM-certified personnel will perform in team concept only under supervision of a certified TL.</p>
INDIVIDUAL (I)	<ol style="list-style-type: none"> 1. Same as for team member (TM) above. 2. Has sufficient knowledge and has demonstrated the proficiency of the work task alone, or trains others in safe and reliable operations. 3. Capable of interpreting the requirements, applicable checklists, SOP, and assembly/operating manuals.
TEAM LEADER (TL)	<ol style="list-style-type: none"> 1. Same as TM and I above. 2. Has sufficient knowledge and has demonstrated the proficiency to direct the performance or training of others, in safe and reliable operations.
QUALITY ASSURANCE (QA)	<ol style="list-style-type: none"> 1. Same as I or TL above. 2. Must have detailed knowledge and ability to train others in applicable explosive device/systems inspection criteria and be able to decide that the necessary assembly or installation procedures have been completed per applicable directives. <p>NOTE: Only TM, I, TL, and QA are interrelated. Certification at the QA level automatically assumes the individual has all knowledge and skill levels required of the TM, I, and TL member.</p>
SAFETY OBSERVER (SO)	<ol style="list-style-type: none"> 1. Must have sufficient knowledge of safety <u>procedures</u> and the <u>functioning</u> of <u>safety devices</u> to decide subsequent reaction when safety procedures or devices are not properly used 2. Certification at the SO level does not require prior certification at any other level. <p>NOTE: The certification level is not restricted to the most senior within a unit. A junior who possesses the foregoing standards and demonstrated maturity may likewise be certified.</p>

equipment at shore activities must also be certified and licensed.

3. Instructors of formal courses or command-approved courses in any of the functions, tasks, or evolutions involving explosives.

Team qualification and certification are required for personnel whose duties require handling, inspecting, packaging, unpacking, assembling, disassembling, testing, fuzing, loading, or downloading (aircraft, launchers, and so forth), stowing, arming, or de-arming of explosives or explosive devices while acting as members of a team or work group. Additionally, a team leader must be designated and appropriately qualified and certified. Personnel changes in certified teams must be kept to a minimum. Requalification and recertification of a team after personnel changes have occurred are at the discretion of the commanding officer or officer in charge. Shipboard gun crews are considered to be teams for the purpose of qualification and certification.

Contractor personnel who are required to perform, at a naval activity, any of the functions discussed in this chapter must provide the commanding officer or officer in charge with documentation that verifies their qualification and certification level before they perform such functions. All contracts, when issued and also when renewed, that deal with explosives and explosive operations contain a provision stating that personnel used for explosive-type operations must be qualified and certified for the type of operation to be performed.

Certification, unless revoked for cause, is valid for a maximum of 12 months. A renewal of the certification, whether issued at the time of expiration or later, should be granted only after the certification board has validated the individual's or team's qualification. Whenever possible, requalification should be completed before certification is renewed.

Revocation of Certification

Commanding officers and officers in charge may revoke individual and team certifications whenever such action is in the best interest of safety. Revoking certification for individuals or teams, including the team leader, is mandatory if an explosive mishap is caused by failure to follow authorized procedures. Flagrant disregard of safety precautions, reckless operation of equipment used to handle explosive devices, or other behavior indicating incompetence or unreliability is also cause for mandatory revocation of

certification. Personnel whose certification has been revoked must be retrained until they are requalified and recertified if the commanding officer considers such action appropriate. If, however, an individual's behavior indicates that retraining may be ineffective, he or she must be assigned other tasks not involving explosive devices. Whenever the certification of a military member is revoked, an entry must be made in the member's service record stating the specific reason for the revocation.

Transfer of Certification

When military personnel are transferred to another activity, the commanding officer or officer in charge of the receiving activity has the discretion of accepting or rejecting the certification. The transferring activity must enter in the appropriate section of the service record the individual's qualifications and dates of certification/decertification for specific evolutions involving explosive devices. Civilian employees who transfer to another activity must be recertified before being allowed to handle any explosive devices. If they are transferring to another function within the same activity, civilian employees must be certified for the new function, unless they currently hold a valid certification for that function.

The requirements for certification, revocation, and transfer of certification of nonnuclear ordnance explosives handlers are contained in OPNAVINST 8023.2C, *U.S. Navy Explosives Safety Policies, Requirements, and Procedures (Department of the Navy Explosives Safety Policy Manual)*.

To continue our discussion on the safe handling, shipping, and storing of conventional explosives, we will look first at the "handling" portion.

- Q3. What is the purpose of the Explosives Handling Personnel Qualification and Certification Program?*
- Q4. Who can authorize the use of live ordnance for training purposes?*
- Q5. Once an individual is certified to handle explosives, for how long is the certification valid?*

AMMUNITION HANDLING

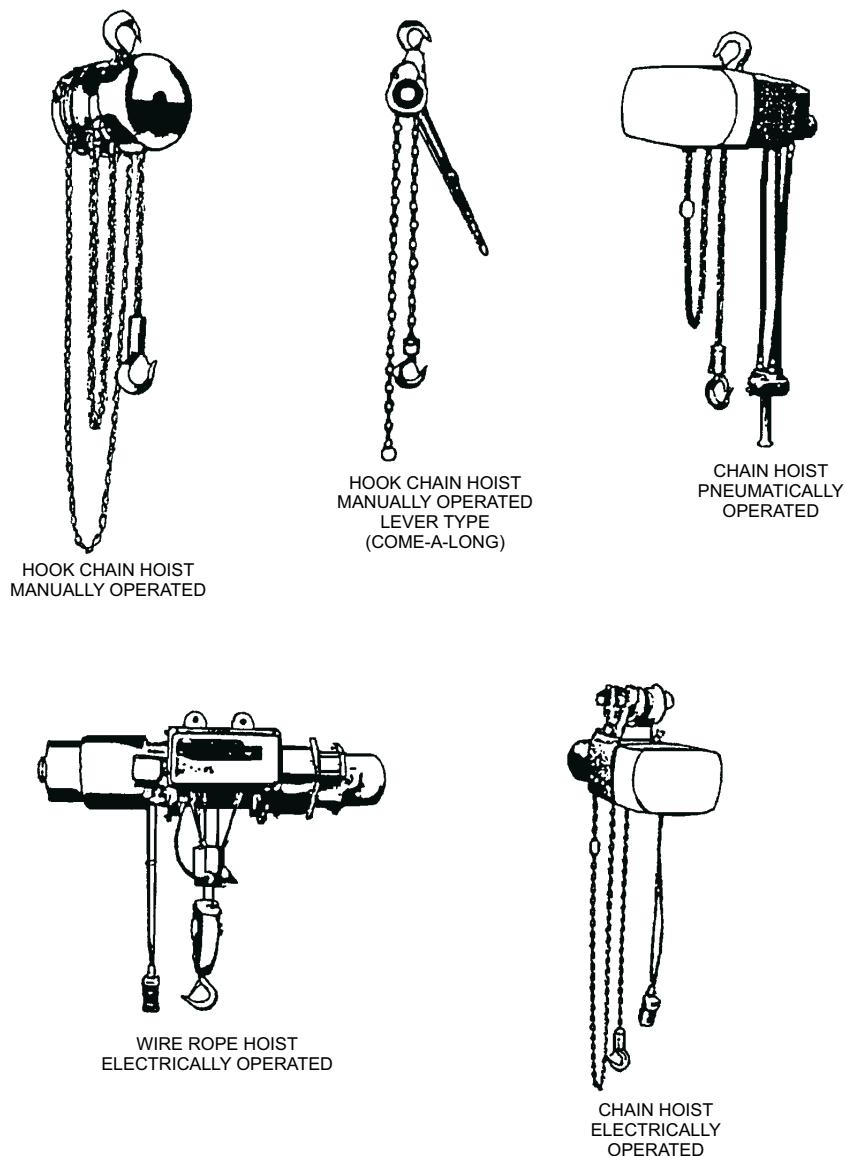
Handling ammunition, in any environment, requires detailed planning, precise execution of details, and strict compliance with safety regulations. For ammunition handling aboard a ship, the

importance of these requirements cannot be over-emphasized because of the limited working space and the large number of personnel contained within the ship. All personnel (both military and civilian) involved in ammunition handling must be thoroughly trained (qualified and certified) in their areas of responsibility.

The following discussion will cover certain aspects of handling equipment and the elements of ammunition handling operations.

HANDLING EQUIPMENT

As a team member, you will use a variety of ammunition handling equipment. Examples of handling equipment include hoists and trolleys (figure 5-1), missile transfer dollies (figure 5-2), and hand lift trucks (figures 5-3 and 5-4) to name but a few. Each weapon has its own type of handling equipment. Therefore, you should consult the applicable OPs and to ensure that you have all the equipment needed to properly handle and stow the weapon(s).



FC05001

Figure 5-1.—Hoist and trolley.

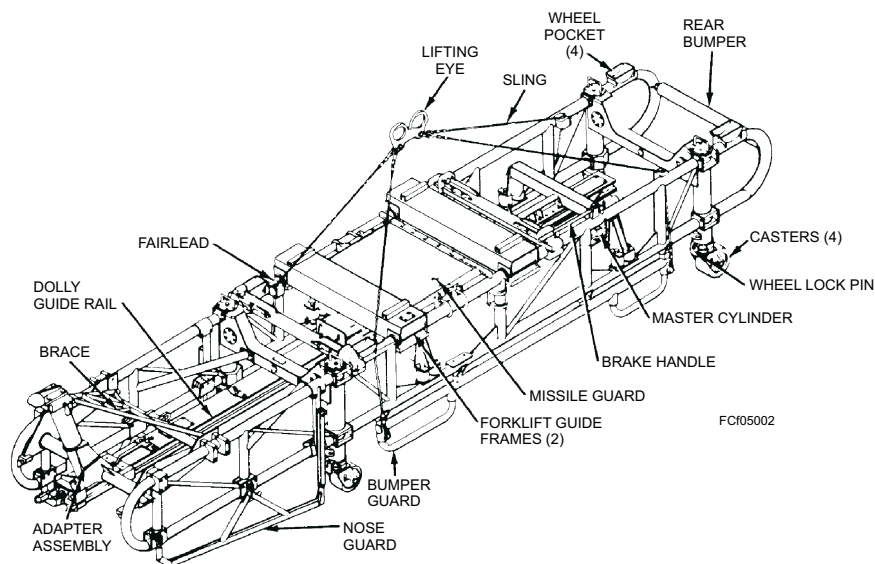


Figure 5-2.—Missile transfer dolly.

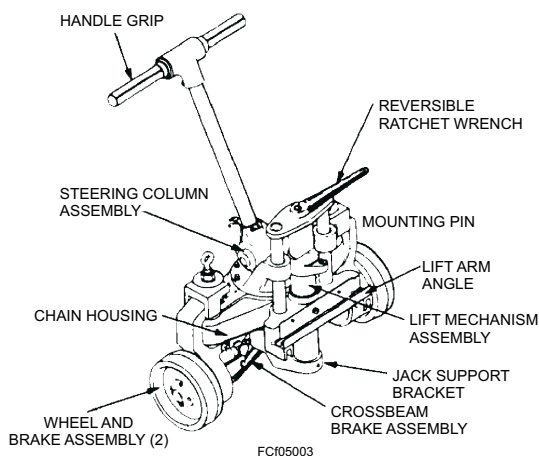


Figure 5-3.—Mk 45 hand lift truck.

In addition to gear for general use, some specialized portable gear has been developed for unique handling problems on specific ships or classes of ships. It is used for both conventional ammunition and nuclear weapons depending on design and application. You will need to refer to operating

procedures, handling and stowage manuals, or ship class drawings for identification and use of this specialized gear.

Equipment that is used frequently for lifting and transferring weapons from one location to another includes hoists, elevators, traveling cranes, floating cranes, forklifts, and hand trucks.

HANDLING OPERATIONS

The task of ammunition and explosives handling is, by nature, hazardous. Accidents occurring during these operations may kill or injure personnel, destroy essential supplies, damage valuable equipment and property, and reduce the speed and efficiency of the handling operation. Most accidents do not just happen. They are caused by carelessness or unfamiliarity with the use and limitations of handling equipment as well as laxness or failure to observe safety precautions, orders, and regulations pertaining to the handling and storage of ammunition and explosives. Accidents caused by misuse of handling equipment can be

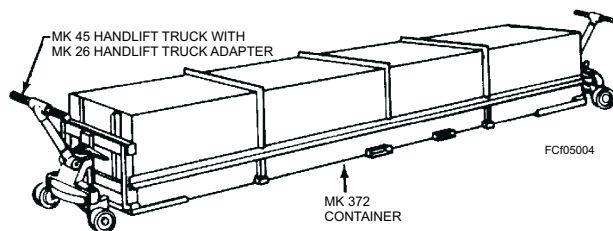


Figure 5-4.—Handling a canister with Mk 45 hand lift trucks.

prevented by a thorough understanding of its operation, use, and limitations. In all cases, the supervisor is responsible for ensuring that personnel assigned as handlers are trained in the use of the handling equipment to be used in each operation and understand the limitations of the equipment.

An ammunition (explosives or explosive material) handling operation includes one or more of the following evolutions.

- Logistics movement.— The transfer of ammunition to or from a ship at an authorized handling location. The transfer may be to or from the pier, a vehicle, a small boat, another ship, or other approved transportation.
- Strike up/strike down.— Any movement of ammunition into or out of the normal stowage locations or magazines of the ship. It may also be part of a logistics movement or part of a maintenance movement.
- Maintenance movement.— Any movement of ammunition from its normal shipboard location to another location to conduct required assembly, disassembly, maintenance or tests of a weapons system, or maintenance of a stowage area. A maintenance movement may include strike up/strike down, movement within the normal stowage area, or movement from one stowage area to another. Maintenance movements include, but are not limited to the following:
 - Removal of projectiles or missiles from tubes or launcher stowage cells for planned maintenance of the tubes or cells
 - Movement of ammunition from ready stowage locations in gun mount handling rooms while conducting maintenance in the area
 - Movement of ammunition to test or repair magazine sprinkler systems or other protective devices
 - Movement of ammunition for installation or checkout of modifications to weapons stowage areas, or to handling, launching, or direction systems
 - Movement of all-up weapons for disassembly or movement of the explosive components of weapons for combining into a higher state of assembly

- Maintenance of weapons in tenders (ADs/ASs). The assembly, disassembly, repair, maintenance, or testing of weapons or weapon components in an authorized weapons shop of a tender.

As a FireControlman you must become familiar with the handling of explosives. It will become a repetitious task, whether at a shore station or aboard ship. However, any repetitious work, no matter how dangerous, is likely to become routine and lead to carelessness. Therefore, you must be constantly vigilant to prevent mishaps in operations involving explosives. Your supervisors will be constantly vigilant and will exercise close supervision to prevent mishaps.

Now, on to the “shipping” of ammunition.

Q6. What type of handling evolution involves the transfer of ammunition from one ship to another?

AMMUNITION SHIPPING

An important aspect of ammunition handling is transporting or shipping explosive materials. We mentioned earlier in this chapter that projectiles, missiles, and some of their components are shipped in specially constructed, airtight containers. When placing weapons in these containers, you should follow the packing procedures given in the associated publications for the weapons.

General instructions for preparing and shipping naval ordnance materials are contained in NAVSEA SW020-AC-SAF-010, Volume 1 and Volume 2, *Transportation and Storage Data for Ammunition, Explosives and Related Hazardous Materials*. These publications contain information that you and your supervisors need to ship explosive materials efficiently and safely. If you are stationed at a facility where normal day-to-day operations involve receiving and shipping explosive materials, you should be familiar with the contents of NAVSEA SW020-AC-SAF-010.

EXPLOSIVES DRIVER

Sometimes Fire Controlmen are assigned the duty of driving trucks that transport explosives or of operating the forklifts and cranes that load and offload the trucks. Basically, an explosives driver is a person with an excellent safe driving record, who is fully qualified according to NAVSEA OP 2239, *Motor Vehicle Driver's Handbook Ammunition, Explosives and Related Hazardous Materials*. If you are assigned

duties as an explosives driver take a good look at the requirements you must meet to become certified to drive motor vehicles that transport ammunition, explosives, and hazardous materials.

Let's continue now with the requirements for storing these hazardous materials safely.

Q7. What NAVSEA OP should you use to find general instructions for preparation and shipping ordnance items?

AMMUNITION STOWAGE

As a Fire Controlman, you will be responsible for the care of projectiles, missiles, and associated components while they are in stowage. This is an important task because these weapons and components will spend about 99 percent of their existence in stowage. This care is even more important aboard surface ships and submarines. Why? Because at shore stations weapons are stored in their shipping containers inside magazines. Aboard surface ships these weapons are stowed in missile tubes or magazines and are exposed to salt water and humidity. A large part of your job will involve maintaining the environmental control and fire suppression systems in magazines.

MAGAZINES

A magazine is any compartment, space, or locker used, or intended to be used, for ammunition stowage. From the magazine, we can expand to the "magazine area." A magazine area includes all compartments, spaces, or passages next to or surrounding a magazine. These places are used, or intended to be used, as the area for handling and passing ammunition. The areas around loaded freighters, railroad cars, and trucks are treated as magazine areas, too. The safety and security measures that apply to shipboard magazines and magazine areas also apply to these "portable" units.

Each magazine is specifically designed for the ammunition it will contain. As a general rule, different types of ammunition will be stowed in separate magazines or lockers. The highest possible degree of safety is obtained by not mixing different explosives in the same magazines or lockers.

However, there are exceptions to this rule. Some stowage areas can be designated single-purpose or multipurpose magazines. While single-purpose stowage is desirable, it is not always possible. Often a ship's mission requires it to carry a variety of

ammunition. Mixed-stowage in multipurpose and certain single-purpose magazines is acceptable. But, there are limitations and restrictions to mixed-stowage. Current safety instructions must be followed and proper authorization must be obtained for mixed-stowage. When mixed-stowage is authorized, it must conform, as close as possible, to the permissible stowage tables listed in NAVSEA OP 4, *Ammunition Afloat*.

There are five major types or classes of magazines. We will discuss the four types you will most likely encounter: primary magazines, missile magazines, ready-service magazines, and lockers. The fifth type is called a chemical magazine. Only lethal and incapacitating chemical ammunitions will be stowed in these extremely special magazines. Normally, chemical ammunition is not carried aboard ship.

A ship's primary and ready-service magazines normally stow its complete wartime allowance of ammunition.

Primary Magazines

Primary magazines are usually located below the main deck, preferably below the ship's waterline. Primary magazines must be well-insulated, ventilated, and have some means of temperature control. They must also have a sprinkler system that can be activated from both remote and local stations. Primary magazines must be closed and locked when unattended.

Missile Magazines

Due to the nature of guided missiles, a fine-line distinction exists between a missile magazine and a primary magazine. Most of the differences are minor and can be related to two factors. First, missile magazines contain various electrically- and hydraulically-powered equipment. Quite often, there is little or no physical separation between this equipment and the missiles. Therefore, the potential for fire is great. Fire detection and suppression assumes greater importance in missile magazines. Second, missile magazines are located close to their launchers. This closeness is necessary to reduce loading time and to support high rates of fire. Thus, missile magazines are generally located above the ship's waterline. For this reason, missile magazines are less protected than primary magazines and are more susceptible to battle damage and fire.

Missile magazines contain special features to combat the effects of accidentally ignited rocket motors. Restraining latches (e.g., cell latches) keep each missile from moving in the magazine. Blowout hatches, relief ports, and plenum exhaust vents pass rocket motor gases to the atmosphere. This prevents internal magazine pressures from building to dangerous levels.

Missile magazines are normally equipped with special combustion detection devices and contain automatic sprinkler systems, with remote and local activation capabilities. Missile magazines also have a water injection or booster suppression system. A carbon dioxide system may be installed in some magazines, especially in unmanned spaces. Missile magazines are insulated, have temperature control systems, and must be closed and locked when unattended.

Ready-Service Magazines

Ready-service magazines are located near the missile launcher they serve. They provide permanent stowage for part of the ship's ammunition allowance, especially gun-type ammunition. Generally, ready-service magazines have many of the same characteristics as primary magazines. They are insulated, ventilated, and have manually activated sprinkler systems.

Missile magazines, although in a class by themselves, are sometimes considered as ready-service magazines. Ready-service magazines must be closed and locked when unattended.

Lockers

A locker can be a small compartment or space. More often though, a locker is a metal box-like structure. In either case, a locker provides stowage for special types of ammunition such as detonators and pyrotechnic devices.

Lockers are frequently located on a ship's weather deck. They will be close to the weapon or area they are intended to serve. A label installed on the outside of each locker clearly identifies the type of explosives contained within the locker.

The contents of a locker must be arranged in a neat and orderly manner. When the locker's lid or door is closed, it cannot contact (or jam) any part of the ammunition. Securing and safety latches, hinges, and other hardware must be well-maintained and in good

working condition. Sometimes, lockers are equipped with a sprinkler or flooding system. If such a system is installed, clear and legible operating instructions must be prominently displayed. Lockers must be kept closed and locked when unattended.

ENVIRONMENTAL CONTROLS

Magazines are fitted with appropriate environmental control and safety features to protect their ammunition from excessive temperatures and humidity.

Most magazines are equipped with mechanical cooling or ventilation systems. However, there are a few magazines that do not have either of these features. If a magazine without controls shows a heat gain in excess of 100° F, portable ventilation systems are used to prevent overheating or condensation of moisture.

Supply and Exhaust Ventilation

Ventilation ducts and exhaust ventilation outlets to and from magazines provide forced-air ventilation. Air is forced through the ducts by electric fans installed within the ducting. Standard covers maintain water-tightness keep flames caused by hits on the ship during combat from entering the magazines. These covers must always be closed during combat (general quarters) conditions unless there are imperative reasons for doing otherwise.

Certain types of ammunition may produce fumes that, if inhaled, may have a slightly intoxicating effect. However, this should not appreciably reduce individuals' work efficiency. Generally, there is sufficient air volume in large sealed magazines and handling rooms to provide a safe working atmosphere.

Frequently, in hot climates, magazines can be maintained at a lower average temperature by closing off the supply of air during the heat of the day and running the blowers only at night when cool air can be forced in. During the day the magazine will heat slowly by conduction rather than rapidly by the introduction of heated air.

Magazine Vent Check Valves

It may be necessary to operate the sprinkler system in magazines while the ventilation valves are secured. During these times; the magazine must be vented by an air escape to ensure that the pressure within the magazine will not build up beyond the allowed pressure limits of the watertight boundaries. Magazine

check valves allow air and water to escape from the magazine into one of the ventilation ducts or through an independent air escape.

Exhaust Vents

Most magazines, particularly missile magazines, are vented to the atmosphere. When missile motors burn, they rapidly produce large volumes of smoke and gas. If a missile motor should accidentally ignite in a magazine, the smoke and gas will be vented directly to the atmosphere, rather than to other areas of the ship. The area on the weather deck in the vicinity of an exhaust vent is potentially hazardous and is marked to warn personnel not to loiter in the area.

Magazine Alarms

Magazines are equipped with various alarm and sensing devices. When activated, they provide audible and visual warnings that something is wrong. An alarm may mean that an actual problem exists or that a problem is developing. Designated personnel should investigate any activated alarm immediately. The following paragraphs discuss three common alarms.

FH ALARM CIRCUIT.—The FH alarm circuit is used with a magazine's sprinkler system to indicate two system problems: leakage and activation. Leakage indicates that a problem is developing. Actuation means that water is flowing and the ammunition is getting sprayed. Actual sprinkling can result from a real fire or a high heat buildup in the magazine. It also can result from a gross sprinkler system malfunction. In any case, appropriate action must be taken immediately.

F ALARM CIRCUIT.—The F alarm circuit is also known as the high-temperature alarm circuit. It sounds an alarm when magazine space temperature reaches a dangerous level. If the F alarm sounds, you should investigate the problem immediately! If you react quickly enough, you may be able to take measures to reduce the temperature. This may prevent the sprinkler system from activating.

COMBUSTION GAS AND SMOKE DETECTOR.—Some magazines may contain a combustion gas and smoke detector. This detector is another early warning device similar to a smoke detector in a house. It detects the presence of combustion gases and smoke particles in the air formed in all types of fires and in smoldering or overheated materials. These particles are so small that they are

invisible to the human eye; however, they are present before there is any evidence of flame.

MAGAZINE INSPECTIONS

Aboard ship, magazine inspections are mandatory and are an integral part of the ship's PMS. These inspections must be conducted by qualified personnel using a check sheet (maintenance requirement card) to ensure that a hazard or abnormal condition is not overlooked.

It is not within the scope of this manual to discuss in detail the criteria of all required magazine inspections. However, we can provide a brief description of daily magazine inspection requirements.

Daily Visual Inspections

The daily visual inspection of magazines generally consists of checking for improperly secured stowage, unsatisfactory protective packaging, unusual fumes or odors, magazine cleanliness, and any other abnormal condition.

Abnormal conditions in a ship's magazine or ammunition stowage space include evidence of tampering to gain access (broken, damaged, or missing locks), evidence of theft, and the presence of unauthorized materials. Abnormal conditions also include evidence of localized overheating from adjacent compartments on decks, bulkheads, and overheads; indications of leaks from sprinkler or flood pipes, nozzles, or control valves and regulators; and inoperable or damaged reachrods, linkages, automatic fire alarm devices, and other similar equipment.

Another important requirement of the daily inspection is to observe, record, and report maximum and minimum temperature conditions.

Magazine Temperatures

Temperature is the most important factor that affects powder and propellant stability. This is why it's important to monitor temperature conditions.

Temperature readings are normally taken once a day. The exact time may vary, but most ships take the readings in the morning (around 0800 for example), using a special maximum and minimum thermometer (sometimes called a high-low thermometer). Figure 5-5 illustrates a typical maximum and minimum thermometer.

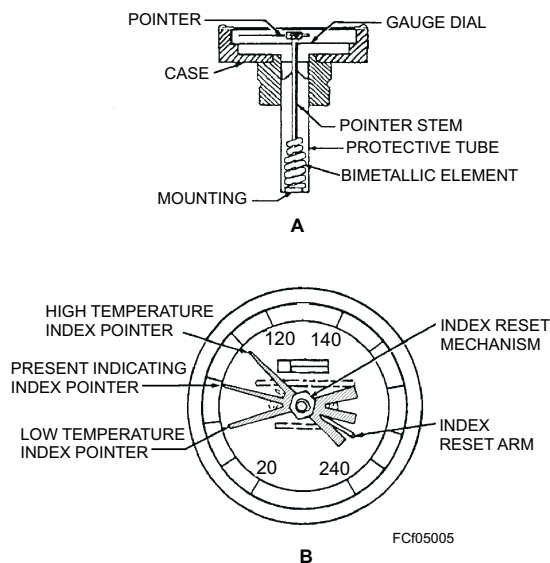


Figure 5-5.—Bimetallic maximum and minimum thermometer: A. Internal components; B. Dial face and pointers.

Every magazine or locker will have at least one direct reading thermometer. It will be located where maximum space temperature variations will normally occur. It must be installed so it is readily accessible for taking readings and resetting the index pointers. Special brackets are available to mount the thermometer where it can be protected from accidental damage.

View A of figure 5-5 shows the internal components of the device. The temperature-sensitive element is a single helix low-mass coil (bimetal element) that fits closely inside the thermometer stem. The bimetal element is carefully sized and aged for lifetime stability and is covered with a fluid to assure good heat transfer. The fluid also permits maximum speed of response and reduces pointer oscillations caused by outside vibrations. The case and stem are made from stainless steel for strength and anticorrosion protection.

View B of figure 5-5 illustrates the dial face of the thermometer. It is 3 inches in diameter. A plastic window protects the index pointers. The index reset arm is on the outside of the window and is used to reset the high-low pointers. Temperature gradations on our example are marked off in 20° increments. The approximate readings on this thermometer are 100° F, high; 78° F, present; and 55° F, low. After you record these temperatures, reset the “high” and “low” pointers in line with the “present” pointer. As temperature rises during the day, the “present” pointer pushes the “high”

pointer up the scale. As temperature falls during the night, the “present” pointer reverses direction and pushes the “low” pointer down the scale. As the sun comes up, the “present” pointer again moves up the scale. Thus, we see three different temperature readings. They reflect the temperature variations throughout a 24-hour period.

The 45° spread between the high and low pointers in our example is a bit large. However, it could happen. The reading you must be cautious about is the 100° F high. When this occurs, you should turn on the magazine cooling or ventilation system. If these systems are not working, you might have to use artificial cooling (fans, blowers). Topside lockers may require cooling with water. Remember, the optimum temperature should be around 70° F.

A magazine temperature record card (fig. 5-6) is located in each magazine and is posted near the thermometer for recording daily magazine temperatures. These cards are replaced on the first day of each month. The completed cards are removed from the magazine and the temperatures for each month are posted in a permanent log. The magazine temperature cards must be retained on file for a period of one year.

When magazine temperatures are recorded in the permanent log, temperatures in excess of 100° F must

MAGAZINE TEMPERATURE RECORD			
5ND GEN 90 (REV 11-48)			
COMPARTMENT	THERM. Number		MONTH
A 304 M	279		APRIL
DATE	MAXIMUM	MINIMUM	INITIAL
1	84	72	OP4C
2	82	70	OP4C
3			
4			
5			
6			
29			
30			
31			

P&PO N or Va 11-2-48 99014 (J c 8) 8M

Figure 5-6.—Magazine Temperature Record Card.

be recorded in a conspicuous manner (red ink). If the temperature exceeds 110°F in smokeless powder, rocket motor and JATO magazines, the temperature must be checked hourly and recorded in a separate notebook. These recorded temperatures are transferred daily to the permanent log. Any magazine in which the temperature is consistently above 100°F must be reported to the Naval Sea Systems Command (NAVSEASYS COM).

Cleanliness in Magazines

All magazines and other spaces containing explosives must be kept scrupulously clean. Combustible materials such as paper, oily rags, cotton waste, solvents, and volatile liquids are not permitted in or near a magazine except when they are being used for approved purposes. Care must be taken to ensure that no steel wool, sand, gravel, or other abrasive substances are on the decks or other working places where explosives are handled. The bulkheads, overhead, and deck should be wiped or washed down as often as necessary to keep them clean. All ammunition holding and securing devices must be kept free of oil, grease, and paint.

Work in Magazines

No work may be performed in a magazine or explosive stowage area unless it is required by ship design or as part of stowing and unstowing procedures (canning, decanning, loading, and unloading dollies, etc.) or is otherwise necessary and unavoidable. Work in a magazine normally is limited to such activities as admitting and stowing hazardous munitions, removing articles stowed in the magazine, keeping the stowage space clean, and maintaining the equipment in the magazines. Before any work that might cause abnormally high temperatures or intense local heat in a magazine or adjacent compartment used primarily as a magazine is performed, all explosives should be removed to other safe stowage. They should not be returned to the magazine until the work is completed and normal conditions are restored.

Appropriate warning, safety precautions, and instructions must be posted conspicuously in all areas where explosives, dangerous chemicals, or other hazardous materials are stowed. Training must be conducted on a regular basis to ensure that all personnel are aware of the meaning and intent of all warning signs, safety precautions, and instructions.

Food, drink, and smoking are prohibited in a magazine or magazine area. Personnel are not permitted to carry cigarette lighters or any type of open flame, or spark or flame-producing apparatus in these areas.

Electrical switches, junction boxes, and convenience outlets must be protected with watertight fittings. Be sure to keep protective caps and covers installed on these fixtures. Magazine lighting may be either fluorescent or incandescent. The light fixtures must be watertight, installed properly, and well-maintained. Be sure to use the proper size bulb where plastic protective globes are used. Never have a naked, unprotected light in a magazine.

Sound-powered telephone circuits are usually installed in magazine spaces. They should be tested routinely and maintained in good condition. Traffic and working areas of certain magazines will have a nonskid deck covering. There are different types of coverings available, so check current instructions for the approved materials.

Ammunition magazines must be identified properly and clearly. In addition to the standard compartment designators, another important sign or label must be in place. This marking is commonly called the AMMUNITION FAR SIDE sign. The sign (fig. 5-7) will be installed on all bulkheads, decks, and overheads surrounding a magazine. On vertical bulkheads, the signs should be 5 feet above the deck and spaced every 12 feet apart. On horizontal decks and overheads, the signs should be 12 feet apart and located to ensure maximum visibility. The sign should not be installed where it is visible from outside the ship. The sign is a yellow rectangle, 5 inches high by 9 inches wide. Painted on the sign are black slanted lines, 1/8-inch thick and one-inch long, on 3/4-inch centers along the top and bottom edges, with lines slanting from top right to bottom left. The letters are 1/8-inch thick and 3/4-inch high.

Magazine Security

All ammunition stowage spaces containing ammunition or explosives are required, by current directives and instructions, to be secured and locked unless work is actually being performed within the space. Properly securing an ammunition stowage space includes ensuring that all environmental controls are properly set and that all hatches, doors, or accesses are closed. It also includes ensuring that all dogs are

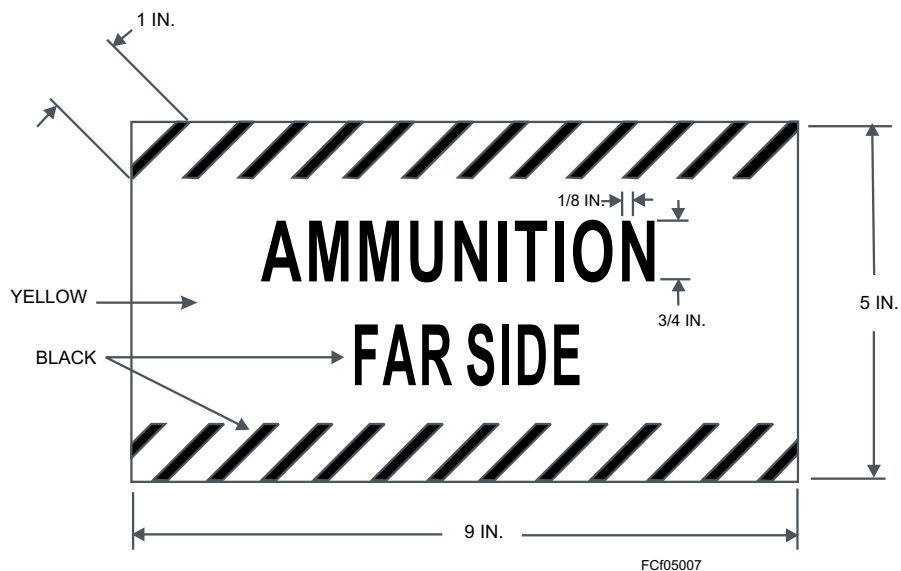


Figure 5-7.— AMMUNITION FAR SIDE, sign or label (example).

properly set on watertight closures and that the space is locked with an adequate locking device.

Only authorized personnel are permitted in a magazine and then only when they have business there. A magazine is no place in which to sit and “shoot the breeze.”

Some ammunition and explosive items such as small arms ammunition, small arms, and pyrotechnics are considered to be highly pilferable and must be stowed only in high-security stowage spaces.

Additional information on magazine security is contained in OPNAVINST 5530.13, *Physical Security Instructions for Sensitive Conventional Arms, Ammunition, and Explosives*.

There is one more aspect of ammunition stowage that we need to discuss. This is the magazine sprinkler systems used for emergency cooling and fire fighting on board ship.

SPRINKLER SYSTEMS

Sprinkler systems provide emergency cooling and fire fighting capability in magazines, ready-service rooms, and ammunition handling areas. A magazine sprinkler system consists of a network of pipes secured to the overhead and connected by a sprinkler system control valve to the ship’s saltwater fire main. The pipes are fitted with spray heads or sprinkler head valves arranged so that the water forced through them showers all parts of the magazine or ammunition handling area. Magazine sprinkler systems are capable of completely flooding their designated spaces. To

prevent unnecessary flooding of adjacent areas, all compartments equipped with sprinkler systems are watertight.

The fire main pressure on most ships is considerably higher than the pressure that magazine bulkheads can withstand; therefore, magazines are equipped with exhaust ventilators located in the bulkhead near the overhead. An exhaust ventilator is a pipe with a check valve that permits pressure release (usually to the topside). The diameter of the pipe is large enough to allow water to flow out as fast as it flows in. This prevents excess pressure from building up in the magazine compartment. On newer ships, magazines are also equipped with capped drainpipes located in the bulkhead near the deck. The caps may be removed in the adjacent compartment to drain the flooded magazine.

There are two basic types of hydraulically-controlled sprinkler systems; the dry-type and the wet-type.

Dry-Type Sprinkler System

A dry-type sprinkler system is one in which the piping from the outlet side of the main sprinkler control valve up to the sprinkler heads contains no water in a normal or ready state. This piping remains “dry” until the system is activated. The sprinkler system may be activated automatically or manually.

An automatic system is designed to actuate the magazine sprinkler in response to either a rapid rise in temperature or a slow rise to a fixed temperature.

The thermopneumatic elements, which monitor the temperature of the magazine and activate the sprinkler system, generate a pneumatic signal in response to thermal action. The pneumatic signal can be either a sudden increase or decrease in air pressure, which will actuate the sprinkler system.

The automatic control system consists of fixed-temperature units (FTUs), heat-actuated devices (HADs) heat-sensing devices (HSDs), transmission lines (Rockbestos™-covered copper tubing), circle seal check valves, and a pneumatically released pilot (PRP) valve. Manual control valves located at separate local and remote control stations are used to activate the system manually.

Wet-Type Sprinkler System

A wet-type sprinkler system is one in which the piping between the outlet side of the main sprinkler valve and the sprinkler heads is charged with fresh water. Once the system is activated, the fresh water is immediately discharged and replaced by salt water.

Although wet-type sprinkler systems do contain quite a few more components than dry-type systems, they function on similar principles. The main advantage of wet systems is a very rapid response time. Sprinkling starts approximately 1 second after activation.

For technical operating information on both types of sprinkler systems, refer to the instruction book, NAVSEA 0348-LP-078-1000, *Magazine Sprinkler System*.

- Q8. What are the five major types of shipboard magazines?*
- Q9. What type of ammunition stowage spaces are frequently located on ship's weather decks?*
- Q10. What alarm circuit is known as the "high-temperature alarm"?*
- Q11. What alarm circuit is known as the "magazine sprinkler alarm"?*
- Q12. Under normal conditions, how often should you take magazine temperature readings?*
- Q13. How should magazine temperatures that are in excess of 100 F be recorded in the permanent temperature log?*
- Q14. What does an "AMMUNITION FAR SIDE" sign look like?*

- Q15. What are the two basic types of hydraulically-controlled sprinkler systems?*
- Q16. Which type of sprinkler system uses fresh water to charge the piping between the outlet side of the main sprinkler valve and the sprinkler heads?*

SUMMARY

You have an important responsibility to handle, ship, and stow ammunition and explosives safely. Remember, the safety precautions and instructions pertaining to the safe operation and use of ammunition and explosives handling equipment must be strictly observed by all naval activities afloat and ashore. The task of ammunition and explosives handling is enormous and, by nature, inescapably hazardous. Mishaps arising in ammunition and explosives handling can kill and injure personnel, destroy essential supplies, and damage valuable equipment and property. Many of these mishaps are caused by carelessness or unfamiliarity with the use and limitations of handling equipment, as well as relaxation or failure to observe safety precautions, orders, and regulations pertaining to the handling and stowage of ammunition and explosives. You can prevent the mishaps that are caused by misuse of handling equipment if you take the time to understand the use and limitations of the handling equipment. Safety precautions and instructions are a vital element of safe ammunition and explosives handling operations. Give them careful and constant study.

ANSWERS TO CHAPTER QUESTIONS

- A1. To warn personnel of hazards that can cause personal injury.*
- A2. To draw attention to situations that may be potentially damaging to equipment.*
- A3. To ensure that each person is qualified and certified before performing any task involving explosives.*
- A4. The type commander.*
- A5. For a maximum of 12 months, unless it is revoked for cause.*
- A6. A logistics movement.*
- A7. NAVSEA SW020-AC-SAF-010, Volume 1 and Volume 2, Transportation and Storage Data for Ammunition, Explosives and Related Hazardous Materials.*

- A8. *Primary magazines, missile magazines, ready-service magazines, lockers and chemical magazines.*
- A9. *Lockers.*
- A10. *The F alarm circuit.*
- A11. *The FH alarm circuit.*
- A12. *Once a day.*
- A13. *In a conspicuous manner (red ink).*
- A14. *The sign is a yellow rectangle, 5 inches high by 9 inches wide. Painted on the sign are black slanted lines, 1/8-inch thick and one-inch long, on 3/4-inch centers along the top and bottom edges, with lines slanting from top right to bottom left. The letters are 1/8-inch thick and 3/4-inch high.*
- A15. *The dry-type and the wet-type.*
- A16. *The dry-type sprinkler system.*